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THE ENGINEER; HUMAN AND SUPERIOR DIRECTION OF POWER[1]

THE forces of nature are the most enduring wealth of mankind. To know their laws and to learn how to apply them has made of a puny little being of about 130 to 200 pounds of flesh and bone—three fourths of which is merely water—a giant of which Gulliver's tales have no equal; and compared to which the largest and most muscular animals of present or former geological periods are merely drowsy, clumsy creatures. All this has been accomplished by his few grams of better brain-matter, which permitted him to gather scientific knowledge and thus to wield powers akin to those attributed to some of the gods of antiquity.

But the forces of nature, in wrong hands, can be diverted from their very highest purposes into the basest demoniacal utilization.

During the late war, one of the nations reputed for its scientific knowledge, staggered history by the wholesale, unscrupulous utilization of science and engineering in attempting to extend and perpetuate an anachronistic and domineering system of government. The other nations, in trying to withstand this onslaught upon right and decency, were in their turn compelled to enlist the talent of scientists and engineers alongside the efforts of soldiers and sailors.

And now, thank God, we chemists can turn again to the sphere of action where we truly belong. We can try anew to become apostles of construction instead of destruction; soldiers of progress, of peace and happiness.

Unfortunately, this does not mean to say that *all* which *all* chemists accomplish is *always* dictated by such lofty motives; no more than liter-

[1] Address presented at the joint meeting of the American Chemical Society and the Society of Chemical Industry (of Great Britain), New York, September, 1921.

ature, or art, or religion is never debased by low aims.

Whatever else this war has brought forth, it has at last taught the ignorant multitude that, in our modern complex civilization, chemists are as indispensable as engineers, notwithstanding the fact that the lawyer-politician still holds the floor.

Nor should the public be blamed too much. The work and purposes of the chemist are not easy to understand to the average man or woman, too often devoid of even rudimentary scientific knowledge, although in some cases they are the bearers of a college degree earned by a one-sided exclusively literary education.

What appears even less obvious, even to the better informed classes, is the relation of the chemist to the chemical engineer. It is less known that a man may be a scientific star of the first magnitude and yet be incapable of utilizing his science in the industries, or of applying it in the many other ramifications of the economics of our civilization—not to speak of the recent applications of science in war. It does not seem obvious to many that there is the same difference between a good grammarian or philologist and a successful writer, be the latter a novelist, an essayist, a journalist or a playwright; that a learned botanist will not necessarily make a successful farmer, no more than a mathematician will surely prove a good accountant, nor a good accountant an able business man, nor a philosopher a successful statesman.

In the same way, explorers frequently make unsuccessful settlers. The true scientist is an explorer in the broadest sense of the word. He explores the laws of nature. By direct observation or experiment, and aided by theoretical reasoning, he tries to correlate the observed facts until he believes that he is warranted to generalize thereon. He thus helps to discover new truths or laws of nature. These, in their turn will permit him to predict facts in advance until further observations or experiments either support him or point out that his generalizations or theories were based on insufficient research or faulty interpretation of the recorded data. Whenever this occurs, he is compelled to turn back on his steps and gather additional knowledge and try better theories. Thus are the methods of science and research. But before any such laboriously gathered knowledge can be utilized, there is a vast amount of further methodic work to be performed.

After a geologist has revealed and surveyed a body of ore in the mountain, the mining engineer and the metallurgist know very well that this does not necessarily mean a paying mine, or a successful smelting works.

So it is in chemistry. The experience of many a scientist has been confined exclusively to laboratory work, or to purely chemical subjects. This is frequently the reason of his weakness in dealing with practical matters, when he is inclined to concentrate his point of view too much on only a part of the subject with which he is confronted. He is apt to neglect other considerations which although seemingly unimposing from a scientific standpoint, frequently carry with them the very elements of success or failure in practical applications.

When, during the war, the problem came up to start the manufacture of optical glass for gunsights and other instruments used in our army or navy, it was easy enough to take care of the chemical side of this subject after raw materials of sufficient purity had been obtained and as long as the glass was produced merely in quantities of a few ounces where the mass could readily be melted in platinum crucibles. But when it came to produce tons of homogeneous optical glass for real wholesale use, then the most tantalizing problem resided in the proper construction and handling of large clay crucibles; this for the simple fact that the molten glass dissolved the clay of the pots and got spoiled by taking up impurities, in the same way as water would dissolve a container made of sugar or of dried mud.

Many a chemical reaction brilliantly successful in the laboratory as long as the operation could be limited to small quantities and carried out in glass, porcelain or platinum vessels, has been doomed to failure when attempts were made to run it on a permanent commercial scale. It needs quite some experience and a good deal of common sense to know when it is

cheaper to simply burn up sawdust waste instead of trying to distill it or convert it into paper pulp, and to know when it is cheaper, for this purpose, to buy expensive wood in the shape of clear logs. It requires quite an effort of good judgment to know when it is less ruinous to burn waste flax straw from our linseed fields than to try to spin or weave it; to know when it is less injurious to one's bank account to leave natural soda and potash salts in lake water instead of obtaining them by the usual processes. That Boston clergyman of about twenty years ago may have had correct chemical information when he started that company for extracting the limitless tons of gold naturally contained in sea water, but if he had been just a little of a chemical engineer, he might readily have concluded that it was cheaper to leave all that gold in the ocean than to try to extract it by methods which cost more than the value of the gold.

Then again, there are cases where even the best of chemists committed errors of judgment and failed to solve problems because they lacked the daring of the engineer.

Sir Humphry Davy, one of the greatest chemists of his age, showed his lack of qualifications as a chemical engineer when he reported unfavorably on the project to use coal gas for the illumination of the City of London. One of his most emphatic objections was that it would require a gas holder as large as St. Paul's Church dome, and even after this was constructed, it would blow up at the first opportunity.

As an opposite example, I should cite the great Belgian engineer, Solvay, who revolutionized the manufacture of soda, one of the chemicals most indispensable to civilization and used in enormous quantities. His success was mainly due to the fact that he was more of an engineer than a chemist. In developing his process, he was unaware that this reaction was not new; that it was so old and so well known that several patents on this very subject were already on record and that, furthermore, the process had been tried commercially about half a dozen times in several countries, and had invariably been unsuccessful. Fortunately, all this discouraging information reached him only after his keen engineering talent had already demonstrated that this elusive chemical process could be controlled in the hands of an engineer and made to operate so successfully as to throw in the scrap heap the older processes used until then.

The pure chemist, confined by the walls of his classroom, his laboratory, or his library, sometimes fails to exercise sufficiently the sense of proportion.

Nor are the engineers, as a class, free from being carried away by a one-sided point of view, although their way of reasoning and grappling a problem is more along quantitative considerations.

The ways of thinking and acting of a chemist and that of an engineer are often along decidedly different points of view. Yet, if these points of view can be compromised, or harmonized, they bring forth good chemical engineering. Nor is this always an easy task. Too often I have seen cases where the engineer, regardless of well-established chemical facts of which he was conveniently ignorant, diligently went on designing the most elaborate and ingenious equipment, giving minute attention to every structural and mechanical detail, and then handed plans and specifications to the chemist to leave the "chemical details" of the problem to the latter. These "details" consisted in specifying a material about as strong as steel, resisting strong acids or other very corrosive agencies, extreme heat, and which should, furthermore, be furnished at a price about that of steel or bronze. When the chemist meekly answered that he knew of no material that would answer the purpose except platinum, iridium, or possibly gold, the information was received with a look of contemptuous disappointment on the part of the engineer.

In another case, a laboratory chemist had been carrying out a chemical process where he heated corrosive liquids under high pressure in sealed hard glass tubes of about half an inch in diameter. In the meantime, he hoped that any engineer forthwith would build him an apparatus with which to perform the same operation in ton lots.

Simple as it sounds, it requires quite some experience, quite some common sense before the chemical engineer knows when to specify stoneware instead of lead, or other metals, or *vice versa,* or to learn how to alter the design of an equipment so as to make it adaptable for each of these different structural materials. I well remember the look of disgust of an engineer who had drawn his specifications of heavy stoneware to within one sixteenth inch of margin, to find out when the apparatus was finally delivered, at the end of several months drying, and baking and waiting, that the dimensions had warped several inches and did not fit with the other parts of the equipment. That very day he learned that it pays to order his stoneware a long time in advance and to wait for its delivery before adjusting the final designs of the adjacent equipment according to what he got from the pottery. I am glad to see that during the competition of the last few years, stoneware manufacturers have made much progress.

In another case, a chemical engineer made a success of a different problem of pumping a corrosive liquid where delicate pumps made of expensive alloys or stoneware were most of the time out of order, until he superseded them by home-made pumps made of cast iron or cement. They corroded very fast, but their construction and replacement were so simple and inexpensive that he could afford to replace them rapidly with much less trouble or cost.

In many chemical industries, after once the initial chemical problems have been overcome, the manufacturing problems resolve themselves to cost of operation and mass production. No wonder then that in such industries the engineer's problems seem to dwarf those of the chemist to such an extent that sometimes the manufacturers seem to be astounded when one reminds them that after all their enterprise is essentially chemical. This is of little consequence in so-called "prosperous" times, when orders are abundant, profits considerable, and when the main problem is one of output. In times of keener competition the unchemically trained directors of such enterprises are sometimes unpleasantly reminded that they need clever chemists as well as good engineers and business men and that, while they were asleep on this subject, their keener competitors have been improving their industries along chemical lines.

Steelmakers or smelters, for instance, are apt to forget that metallurgy is, after all, a very chemical industry where most of the great strides were made through chemical considerations. The same can be said of sugar, glass and soap manufacturing.

To the wide-awake manufacturer, the present industrial depression should be an incentive to engage more chemists, to do more chemical research work, instead of laying off the men of their chemical staff, as has happened in too many instances since we got out of that fool's paradise of so-called "prosperity."

Most of our industries badly need "fertilizing" and fertilizing is better done while the land lies fallow than during planting or harvesting time.

Whenever I see such shortsightedness which is bound to stunt our industrial efficiency for the future, then I wonder whether some of the financial or business men at the head of large industrial enterprises are not occupying their position on an assumed and unearned reputation.

Some of our industries are more particularly adapted to our country on account of an exceptionally abundant supply of the raw materials they employ; this gives them at once a distinct advantage over other countries which have to import these raw products. But precisely in some of these industries, the chemical point of view has been much neglected, except in minor details.

For instance, we have that enormous industry of petroleum refining. Ever since petroleum was first discovered, the processes of rectification have not varied much from the general methods of fractional distillation by which different compounds are separated by order of volatility in light hydrocarbons of the gasoline type, somewhat higher boiling liquids of the kerosene type, then lubricating oils, vaseline or petroleum jelly, and the least volatile and hardest of all, paraffine.

It is true that in this general process of dis-

tillation, improvements have been introduced from time to time. For instance, the intermediate treatment with sulphuric acid, then later the destructive distillation at higher temperatures or the so-called "cracking" processes which break up the more complex hydrocarbon molecules of the heavier distilling liquids and thereby increase the yield of the lighter and more valuable gasoline.

Nevertheless, the fact remains that aside from a relatively small proportion of lubricants, the bulk of raw or refined petroleum is burnt as a fuel. This burning may be done directly in oil burning furnaces, or as refined kerosene in our lamps, or as gas from our gas works, or by a much more efficient way, in our internal combustion motors, varying from the smallest motorcycle engine to the heaviest Diesel generators.

There was a time when coal also was exclusively used as a fuel until the chemists succeeded in converting one of its least attractive by-products, coal-tar, into a series of the most startling syntheses, which opened an entirely new field in chemistry. These coal-tar derivatives include not only an endless variety of dyes, but the many other valuable synthetic substances used in the art of healing and sanitation, as well as the newer synthetic resinous products which have opened new possibilities in electrical insulation and numerous other industries, and the chemicals which are used in the art of photography. Nor should I omit to mention the new explosives obtained from the same source, and which are safer and easier to handle than dynamite or gunpowder, and which find greater and more lasting applications in mining, agriculture and engineering than in war. Agents of foreign interests had long ago started a propaganda campaign among our teachers of chemistry as well as among our congressmen and manufacturers, making them believe that the United States was not suited for this industry of coal-tar products, and that Germany could better supply us. But the war awakened us from our torpor when we were confronted by the fact that the coal-tar derivatives were the indispensable key to many of our most important industries and that the war could not be won without them, and that Germany had lulled us into inaction until, in experience, we were a full generation behind her. By supreme efforts, our chemists and business men overcame this fearful handicap; this achievement remains one of the most brilliant pages of our national history. And now it looks as if shortsightedness and politics were about to destroy what has been raised after so much effort.

But let us return to the subject of the petroleum industry: The abundant existence of this raw material, as well as natural gas, in America is mainly due to the special geological history of this continent. Geological changes here have been less violent, less metamorphic than in Europe or most other countries, so that the geological deposits or stores of these rather fugitive materials have been less disturbed, less broken up by subsequent upheavals.

Especially in natural gas do we possess a raw material which almost exclusively belongs to this country. When we reflect, however, that this raw material cannot readily be transported, we should seek methods to convert it into other commodities which lend themselves to easier transportation.

If we have acted as spendthrifts with our coal and petroleum, we have behaved as barbarians with our natural gas resources until there is little left of it. Yet natural gas contains valuable substances which under the hand of the chemist may be used as a starting point for syntheses perhaps more valuable than what has been accomplished with coal-tar. While the period of brutal waste is not yet ended, the dawn of a more enlightened utilization seems to be in sight. I learned recently that at least one of our more progressive and better organized industrial enterprises has undertaken the problem of more methodical use of natural gas along scientific and chemical lines. From the results already obtained, there is good hope that some day our natural gas resources may provide us with new synthetic products which may open entirely new possibilities in various other industries. I should add that the company in question, notwithstanding the present business depression, has not discharged its research chemists. On the contrary it has recently added

considerably to its research staff and equipment, although endeavoring to cut unnecessary expenses in other directions.

Industrial alcohol is another chemical industry in the United States which seems susceptible of an incomparably wider development as soon as it is less hampered by fanaticism in a more efficient commercial production and easier distribution. The ignorant multitude does not class alcohol as a chemical industry. Most people can not see in alcohol anything but its use or abuse as a beverage.

And yet, outside of such uses, there is hardly a chemical susceptible of wider and more beneficial application in the arts, the industries and the household economics. Its value as a solvent, its use in varnishes, artificial leather, smokeless powder, is well known among chemists. But a much more extended use is possible as a liquid fuel. The fact that it is far less volatile than gasoline and mixes readily with water, makes it not only cleaner, but incomparably less dangerous, whether it be used in the household for heating or illuminating purposes, or whether it be used on a motor car or a motorboat, or stationary engine.

Furthermore, its sources of supply embrace all inexpensive starch- or sugar-containing vegetables, as well as the waste of our sugar refineries, all products of which this country has a prodigious supply.

Converting our perishable farm products into products like alcohol, which can be stored indefinitely and of which the transportation and handling are easy, is one of the ways of equalizing the uncertain fluctuations of the yield of our crops.

Long after every drop of petroleum or gasoline will have been extracted from our wells, every yearly agricultural crop will insure us a new supply of this valuable liquid fuel obtained by fermentation of starch- or sugar-containing liquids. I know of no country where there is such an abundant source of supply, as well as the industrial opportunities in conjunction with an extensive market within easy reach, provided industrial alcohol can be furnished to the consumer at a low enough price.

But unintelligent application of the Prohibition Act will offset all this, whatever good effects it may try to accomplish in other directions, by putting unnecessarily exaggerated restrictions or handicaps upon the manufacture or distribution of industrial alcohol.

Few people realize that the price at which alcohol can be delivered to the consumer at a profit is considerably influenced by whatever unnecessary red tape impedes manufacture, transportation or distribution. The well-intentioned manufacturer who is endeavoring to lower the cost of production, feels his efforts rather futile when they are wiped out at the selling and distributing end.

There is opportunity for considerable improvement in the technical end of this industry in the United States. In this respect, France and Germany were able to furnish better and cheaper alcohol than we were, because in those countries the industrial alcohol situation has always been more considered on its own merits. So has it come to pass that this branch of chemistry or chemical engineering has attracted fewer of our better scientists or engineers in the United States than in other countries. Justly or unjustly, this whole industry has been under the ban of social prejudice on the part of people who, in their zeal, can not discern between the drink evil and an indispensable chemical industry.

Yet, no less a man than the great Pasteur counts among the many illustrious chemists, biochemists and engineers, who have contributed to the development of the alcohol industry. It was Pasteur, while he was professor of chemistry at the University of Lille, who by undertaking to correct irregularities in the fermentation processes of a local distiller, discovered the fundamental truths relating to the phenomena of fermentation. Under his genius, the knowledge gained thereby became the starting point not only of radical improvements in the manufacture of fermentation processes, but they brought forth a veritable revolution in sanitation, surgery, and medicine. All this has sowed broadcast inestimable benefits on mankind, and has made the name of Pasteur sacred to every one who is not too ignorant to

know something about what he has done for humanity.

If every annual crop of starch- or sugar-containing plants can furnish us an abundance of liquid fuel and solvents under the form of alcohol, we may look at this from another point of view and call it simply the stored-up energy of the sun. The photochemical action of the sun rays under the influence of the chlorophyl, or green matter of the plant leaves, brings about the most subtle creative chemical synthesis. Carbon dioxide, a product of combustion, one of the ultimate destruction products of plant or animal life, combines with water under the action of sunlight. Dead matter reenters the process of life. The first, or one of the first products of this synthesis is formaldehyde; the latter, in its turn, inaugurates a succession of further chemical syntheses which result in the formation of sugars, starch, cellulose, and other carbohydrates. No sun, no photochemical synthesis, no crops—no life! So that, after all, the whole living world is dependent upon a delicate photochemical reaction. Starvation, on one hand, or abundance of crops and foodstuffs, on the other, all within the range of photochemistry.

In the same way, our vast coal beds and our petroleum wells and our natural gas, are merely the result of light energy stored up from the plant or animal life of former geological periods. This, in itself, ought to impress us with the enormous possibilities of photochemical synthesis. And yet, here is a field where the scientist or engineer has accomplished next to nothing. In the utilization of this marvelous energy, we have not gone much beyond the art of making photographs.

So here is a power, an energy, which has been much neglected by scientist and engineer alike. Where is the Faraday, the Ampère, the Leonardo da Vinci, where is the Archimedes who shall show us how to use the sun rays for charging our electrical storage batteries, or who will teach us how to handle the photochemical action of sunlight, or to emulate nature in her synthesis of plant life? Who will utilize this delicate method instead of our hitherto brutal processes of synthesis. Nature in her methods of plant life synthesis does not treat with boiling solutions of alkalies or strong acids; she uses no high temperatures nor strong electric currents. If we want to be successful in this direction, we shall have to utilize equipment possessing large exposed surfaces similar to the leaves of plants. We may have to operate in rather dilute solutions instead of the concentrations which are ordinarily used in our present methods. We may have to find means for rapidly separating the formed products as fast as they accumulate. We may be compelled to work within narrow ranges of temperature, perhaps not exceeding those outside of which plant life stops.

But who knows what surprises are in store for us and how we may simplify all this after the subject once begins to receive enough attention.

In the past, scientists have taught the engineers how to transmute the forces of nature, but this took a very long time. About a century and a half ago, Lavoisier, by his memorable work in chemistry, got as far as to exclaim: "In Nature nothing is created, nothing is lost, there are only transformations." But he was thinking of *matter* as such. It took almost a century more before Mayer and Joule proclaimed the same truth in physics as far as forces of Nature or energy are concerned. Our present conception of the conservation and transformation of energy are of rather recent date. Nor were these fundamental truths readily accepted without opposition. Since then, progress has been rapid. Scientists and inventors alike have taught the engineer how to transmute the forces of Nature.

Let us take, for instance, a well-known chemical reaction—the oxidation of carbon and hydrogen; whether this oxidation be accomplished simply by the burning of coal, gas, or oil in furnaces under a steam boiler, or by the internal combustion in any variety of a gas engine, it gives heat which in turn is transformed into motion or motive power, which runs our factories, our ships, our trains, our automobiles, our flying machines. Or, inversely, motion can be turned into an equivalent amount of heat by friction or otherwise, as

every one knows who ever operated an air compressor or had to deal with a badly lubricated axle.

But motion, whether it be furnished by water rushing from a waterfall, or by a steam or gas engine, or by a windmill, can be made to turn a dynamo and produce electrical energy. The latter, in turn, can be changed into motion, heat or light. Or again, we can bridge directly that jump between a chemical reaction and light by simply burning oil, gas, acetylene, or magnesium, and thus produce any range of even the most intense light. Or, in other cases, we use heat or electricity to decompose the most refractory substances in their elements, and some of our largest electro chemical industries in Niagara Falls are based on this. Or we may use either one of these forms of energy in chemical reactions which build up; which, in other words, bring about chemical synthesis.

But when it comes to transforming light energy into chemical synthesis, we have left thus far the monopoly of this agent to Nature; we have been acting as Rip Van Winkles.

In the museum of the Franklin Institute in Philadelphia exists an electrical machine which was used by Benjamin Franklin for his experiments. It was one of the very best electric machines of his day. Yet, at that time, it was a mere clumsy toy. When the weather was not too damp and all other conditions were propitious, the operator, after turning that glass globe until he was red in the face, could draw some insignificant sparks, or charge a Leyden jar, or give a harmless shock to the person who touched it. All this was not so very long ago. Yet that toy was the forerunner of our enormous electrical industries, and all the astounding modern applications of electrical energy; our electric generating stations which give us light, power and transportation, which move our trains, our ships, our factories, which generate power far beyond anything which unscientific man of antiquity, or of a few years ago, was able to dream of. That same electricity which gave us wireless telegraphy and the wireless telephone; which has made the world bigger, and, at the same time, smaller, by rendering every nook and corner more accessible.

Let those who at present lay off their research chemists, their physicists, their research engineers, remember that the tremendous gap between that toy electric machine of Franklin and the present electrical industry, would never have been bridged but for research, invention and good engineering.

L. H. Baekeland

Columbia University

HERBERT HAVILAND FIELD

On April 5 there died in Zurich, Switzerland, from heart failure following influenza, one to whom science and especially zoology owes a great debt. Herbert Haviland Field was not only a man of marked ability and personal charm but he also possessed unusual breadth of vision as well as the power to make his visions realities. By virtue of these traits he made contributions of fundamental and permanent value to the progress of science though he was known to relatively few because of his modesty and self-elimination.

Born in Brooklyn, N. Y., April 25, 1868, of Quaker ancestry which included some of the prominent citizens of that municipality a century ago, young Field had his early education in that city, was graduated from the Brooklyn Polytechnic and went to Harvard. There he took his bachelor's degree in 1888 and kept on until he had won his M.A. in 1890 and his Ph.D. in 1891. His doctor's thesis, a masterful study of the early development of the urogenital organs in Amphibia, gave him at once a high place in the esteem of workers in zoology.

On going to Europe in the following year, he met a cordial reception at the Universities of Freiburg in Baden, Leipzig, and Paris, at each of which he was given the doctor's degree. Even at the start of his studies he was impressed with the failure of investigators to give due attention to the work of the past and recognized that this neglect was due in large part to the lack of means for obtaining an adequate record of the volumi-

nous and widely scattered literature. As he studied this problem in various countries, the need grew upon him and the thought he had, even in student days, of some agency to handle the material in broad and comprehensive fashion took form gradually in the great Concilium Bibliographicum which he conceived, founded, and organized, an enterprise which testifies eloquently to his successful efforts for the advancement of science and the assistance of his coworkers in biology.

Dr. Field was a fine-looking man. Of large size and good figure, with dignified bearing, he attracted attention in any group even though in later years he had manifested a tendency to increase in weight which was, in fact, a trait inherited from his father. Two physical defects are worthy of note. He suffered from a constantly recurring migraine of great intensity. In the early days his friends and associates noted a marked tendency to stammer which became painful at times when he was involved in a vigorous argument. He studied the situation intensively to rid himself of the defect and it did largely disappear. It was, however, striking to those who had noted this peculiarity, to find that his conversation in other languages was entirely free from the difficulty. He spoke withal in an easy, flowing style which was vivid and sparkling, commanding the attention of the listener and carrying conviction to those with whom he was conversing.

His gift of tongues was indeed extraordinary, for in his college days he utilized Latin, German, French, Italian, Dutch, and Russian with apparently equal ease, and he is said to have been accustomed to write his diary in the last-named language. When the seventh International Zoological Congress met in this country it held a session at Cold Spring Harbor, and the delegates were received at Sagamore Hill by then President Roosevelt. At that time Dr. Field, who had known most of them for years, was called upon to introduce the foreign delegates to the President. He conversed readily with those whom he did not know, addressing each in his own language and telling Mr. Roosevelt about them. His exceptional memory was conspicuous to every one who came into contact with him, but most of all, perhaps, to those of us who were his associates day after day in the laboratory at the Museum of Comparative Zoology. He would not only repeat paragraph after paragraph from various lectures but would dazzle us by a record of scientific facts from papers and references to out-of-way publications with a completeness and precision that were remarkable in fields outside of the particular territory in which he was doing his own work. I have been told that his musical memory was even more remarkable. It is said that he would listen to a symphony concert and on returning home would play on any sort of a musical instrument not only the motif and its numerous variations but also whole sections of the composition even though he had just heard it for the first time.

Combined with this fine endowment of a precise and retentive memory was a sense of order and system that was equally conspicuous because of its contrast with the habits of the ordinary man. He was fond of system and had remarkable power for outlining and installing a plan, to organize any given material; this was coupled with unusual power in following out the system and applying it in detail to complex series of data. It must be confessed that in his own work he was not always so systematic. In the laboratory at the Agassiz Museum he worked with the greatest pertinacity and concentration, often not even stopping for lunch. But after some days of such effort, he might absent himself for two or three days at a stretch and would be found visiting or reading at home with equal intensity. Furthermore, he sometimes manifested that absent-mindedness, which some attribute to genius and which affects the little things of every-day life that seem of importance to a smaller man. He would lose one object or another and, after failing to find the thing for which he was looking, would exclaim: " Never mind! I think I left it on the train," or somewhere

else, and go on with the main object of life at that time with absolute unconcern. In this, he manifested the calm that may rightly be regarded as an inheritance from his Quaker ancestry and that undoubtedly carried him through many difficult and awkward situations with an unruffled mind. His exactitude of action was labelled by some as a tendency to procrastinate for he would always turn up just at the moment when a train was leaving or was even already in motion. Such precise punctuality resulted in unfortunate failure sometimes when circumstances beyond his control resulted in minor delays on the way.

His dogged determination is well illustrated by a comment made in personal correspondence from Dr. C. B. Davenport, who was an intimate friend of Field's and to whom I am indebted for great assistance in preparing this sketch. Dr. Davenport writes:

> An exceedingly valuable trait was his pertinacity. I have occasion to remember that, having put my hand to the plow of civil engineering, I was loathe to turn back; but Field had set his heart on my coming to Harvard and he was irresistible. I owe my entrance into biology as a profession to him. This pertinacity showed itself in the way he upheld the Concilium through many dark years and declined alluring invitations to continue his work elsewhere under more favorable auspices. None of these suggestions or appeals seemed to make any impression on him, if they involved a relinquishment of his well-thought-out plans.

Field's greatest work, and the one for which he will always be remembered and through which science has incurred to him an obligation that never can be discharged, was, of course, the Concilium Bibliographicum. To it he devoted his energies with intensity and rare persistence in the face of apparently insurmountable difficulties. Indeed, it would not be in the least an exaggeration to say that the load, which he had been carrying, especially in these months since the end of the war when it seemed as if the project might be put upon a permanent basis, even though it met opposition in some quarters and indifference in others, laid a tremendous burden upon his shoulders. In fact, his intimates had noticed for some months conspicuously that he was overworked even though they had not suspected the collapse which came so suddenly.

While a graduate student at Harvard under the leadership of Professor E. L. Mark, Field became deeply impressed with the need for the systematic rearrangement of the scientific publications where, in the field of zoology, a multitude of articles in hundreds of scattered periodicals were unknown even by title to the workers in the field and could be brought together only at an entirely unreasonable outlay of time and energy. It was computed at one time that there appeared annually upwards of ten thousand notes and articles, distributed through at least fifteen hundred periodicals in different languages. The unsystematic condition of the literature and the delays he saw in work repeated and in time and energy wasted in hunting out the records of the student's predecessors in order that the investigator might start at least on a level with those who had gone before, provoked in his mind the insistent inquiry as to the means for the improvement of the situation and the elimination of this waste. I think there is no doubt that he was stimulated also by the general development of systematic bibliography in the United States. He planned to reorganize the field of zoology and related sciences and to apply the decimal system of classification, then recently developed and published by Dewey. Furthermore he felt that the arrangement of records of the literature in book form fell short of the best plan available, and he proposed to substitute for it an analytical card catalogue through which every new publication would naturally and promptly drop into its proper place, and the student thus be able in a moment's time to gather together all of the publications on a given topic instead of hunting for them through volume after volume of an annual catalogue. Every zoologist is familiar with the splendid way in which this idea was developed and the unparalleled success with which the literature of the subject was indexed, for the Concilium cards have

included a much larger percentage of references in the literature of zoology than has ever been brought together by any other agency. Furthermore, this record has been furnished with a promptness that stands in striking contrast with the leisurely appearance of other bibliographic information. With the rapidly growing literature in this field, it was inevitable that the catalogue, especially in its full form with special cross references, began to assume considerable size, and some critics failed to recognize in this the true condition—the inevitable advancement of a growing field—and commented on the space required as if it were a defect of the system employed.

I recall vividly hearing Field on one occasion respond to such a comment by saying that despite its increase, the catalogue would not in a century reach the dimensions necessary to house a mounted elephant and yet no museum would hesitate to devote much more than that space to the representation of that single species. Field was not only the first to develop these ideas in a practical way, but he assumed the even greater burden of converting the unbelievers and the indifferent, and of securing adequate moral and financial support for the project. He visited the leaders in this country and abroad, secured the unqualified and enthusiastic endorsement of such men as Dohrn in Naples, Carus in Leipsic, Arnold Lang in Zurich, and, especially, of the French zoologists. In connection with the Institut International de Bibliographie in Brussels, he undertook to carry out part of the plan to utilize the Dewey system in the entire range of bibliography, until in the Third International Zoological Congress in Leyden at the instigation of the delegate of the Société Zoologique de France approval and support were enthusiastically pledged to the foundation of the Concilium Bibliographicum to be located at Zurich under his directorship. Subventions were given it officially by Switzerland, the canton and city of Zurich, and by several European governmental and institutional agencies, so that finally in the fall of 1895, Field took up his residence in Zurich and officially opened the work of the Concilium. An American can not view with any large degree of pride the attitude of this country towards the enterprise. While it was receiving vigorous official and personal support in Europe and Field was himself devoting all of his time and a very considerable amount from moderate means to its maintenance, financial cooperation was unfortunately exceedingly limited here. It was a cause of constant regret to Field as his friends knew by his personal communications that so rich and generous a country, which he was always proud to claim as his own, had contributed in such a meager degree to an international enterprise, organized and led by one of its own citizens.

At first, Field was the entire Concilium. He did all its work, cared for its interests, sought out and developed its support, and carried its burdens. Gradually it grew despite indifference and opposition until it had its own printing press and staff of expert workers. Zoologists were forced to recognize the efficiency of the organization and the success of its work. The indomitable energy of its leader, his supreme confidence in its value, and his ability to present its claims in clear and convincing fashion, overcame every obstacle, and year by year it grew to be more extensive and more indispensable until, finally, the war broke. Then all such enterprises were thrown aside and the activities of the Concilium were temporarily suspended. It is worthy of mention that during this period, Field turned with equal energy and devotion to the solution of the problems that presented themselves in the social world and performed important services for his native country and for the mountain republic in which he had found his home. With the close of the war, however, he went back with the greatest eagerness to the work of the Concilium, and in 1920, made a visit to the United States for the purpose of arousing again the interest in the project and securing the necessary financial support. Encouraged by his reception, he returned to Switzerland confident that a new era of opportunity

for himself and the Concilium had opened. But though his sudden and unexpected death has taken him away from this work, no one can believe that men of science will be so lacking in foresight and so blind to their own interests that the great work which he did and the institution which he founded will be permitted to perish.

Field displayed constantly a deep devotion to principles and while easy to work with and ready to yield where the matter in question was only a difference of opinion, he stood like a rock when what he regarded as fundamental issues were at stake. When the project of preparing a general bibiography of science was developed by the Royal Society of London, backed with large subsidies and immense prestige through its official governmental affiliations, the directorship was offered to Field through Sir Michael Foster. It was, however, set as a condicio sine qua non that the decimal system of notation should be abandoned in favor of another employing Latin titles. After careful consideration, Field felt that this was a step backward and would introduce confusion. Consequently, he declined the post despite its alluring features. It is interesting to note that despite the immense resources at the disposal of the Royal Society it never published an annual bibliography anything like as complete as that issued by the Concilium and the references came regularly also a year late. So determined was the opposition to his project, however, that pressure was brought upon universities abroad to bring them to cancel subscriptions to the Concilium, and representations were even made to the Smithsonian Institution and to private foundations in this country that the Royal Society regarded it as an unfriendly act to extend help to the Zurich enterprise. In England, Manchester University protested against this attitude and with characteristic independence the *Manchester Guardian* came out in vigorous defense of the Concilium. In this country, Professors Henry Fairfield Osborn, E. L. Mark, C. B. Davenport, and G. H. Parker were vigorous in their defense of the methods and results of the work done by the Concilium. The American Association for the Advancement of Science made for many years a contribution to the work of the Concilium which, despite the doubts of some members, was taken from the research fund at the urgent request of a large body of working zoologists who asserted emphatically that this institution and its work were the most valuable single adjunct to investigation at the command of the American investigator.

His work won recognition for Field from many sources. He was honorary assistant of the Museum of Comparative Zoology at Cambridge, Mass., trustee of the International Institute of Bibliography at Brussels, Belgium, editor of the Bibliographia Zoologica, fellow of the American Association for the Advancement of Science, and had been elected to honorary membership in a long list of prominent scientific societies.

He was married in 1903 in London to Nina Eschwege, who with their four children is still living in Zurich. Two brothers and a sister are residents of Brooklyn.

Few men have devoted themselves so incessantly and unselfishly to the service of others. If he had withdrawn in his own laboratory and had concentrated on his individual researches his unusual mental endowment would unquestionably have produced conspicuous results. He chose rather to devote himself to the improvement of conditions for his fellow workers. He threw himself into this work with all the powers at his command and what he accomplished has been of inestimable service to a multitude of workers.

Henry B. Ward

University of Illinois

SCIENTIFIC EVENTS

WINTHROP ELLSWORTH STONE

The Associate Alumni of the Massachusetts Agricultural College through their executive committee has adopted the following minute:

Winthrop Ellsworth Stone, an honored member of the class of 1882 of the Massachusetts Agricultural College and since 1900 President of Pur-

due University, lost his life while scaling Mount Eon, a virgin peak in the Canadian Rockies, July 17, 1921.

The Associate Alumni of the Massachusetts Agricultural College, through its executive committee, desire to express and record their appreciation of the fruitful service which Dr. Stone has rendered to education, chemical science and scientific agriculture.

With natural abilities of a high order, he brought to his work scientific training obtained as an undergraduate and graduate student at this college under the guidance of Goessmann, Clark and Stockbridge, as plant pathologist at the noted Valentine Farm, New York, and as a student at the University of Göttingen, where he took his doctorate with Tollens and Victor Meyer. Returning to America in 1888, he became chemist to the Tennessee Experiment Station, a year later accepting a call to the chair of chemistry at Purdue University. It was during this period that he made his principal investigations in the field of agricultural chemistry. After serving for a time as vice-president, he succeeded Dr. Smart as president on the retirement of the latter in 1900. Under his wise and able administration Purdue has attained a leading position among the educational institutions of the country.

He was a lover of manly sports, especially of mountain climbing, the favorite recreation of his later years, and one in which he achieved notable distinction by his ascents of difficult peaks.

Modest and unassuming, yet resolute and resourceful, of unflinching courage, zealous for truth and inspired by lofty ideals, as an educator he stands preeminent among the sons of the college. He will be remembered with high regard, pride and affection by those whose lives were enriched by his friendship, and as one who shed luster on his alma mater.

MORTALITY STATISTICS FOR 1920

THE Department of Commerce announces that the Census Bureau's annual report on mortality statistics, which will be issued shortly, shows 1,142,578 deaths as having occurred in 1920 within the death registration area of continental United States, representing a death rate of 13.1 per 1,000 population as compared with 12.9 in 1919, which was the lowest rate recorded in any year since the registration area was established in 1900.

The death registration area (exclusive of the Territory of Hawaii) in 1920 comprised 34 states, the District of Columbia and 16 registration cities in nonregistration states, with a total estimated population on July 1 of 87,486,713, or 82.2 per cent. of the estimated population of the United States. The state of Nebraska was added to the registration area in 1920, so that at present the only states not in the area are Alabama, Arizona, Arkansas, Georgia, Idaho, Iowa, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, West Virginia, and Wyoming. The figures for the territory of Hawaii will appear in the report, but they are not included in this summary.

The death rate from pneumonia increased from 123.5 per 100,000 in 1919 to 137.3 in 1920. For chronic diseases of the heart the rate increased from 131.0 to 141.9; for cancer, from 80.5 to 83. Some of the other diseases for which the rate increased are whooping cough, measles, cerebral hemorrhage, congenital debility and malformations, puerperal fever, scarlet fever and appendicitis. The fatalities caused by automobile accidents and injuries show an increase from 9.4 per 100,000 in 1919 to 10.4 in 1920.

A marked decrease is shown in the death rate from tuberculosis, which was 114.2 in 1920 as compared with 125.6 in 1919; also in the death rate from influenza, 71.0 in 1920 as against 98.8 the year before. The death rate from suicide declined from 11.4 in 1919 to 10.2 in 1920. There was a decline also in the rate for typhoid fever and in that for accidental drowning.

THE MOUNT EVEREST EXPEDITION

THE British Mount Everest Committee has communicated to the London *Times* the following telegram, dated October 10, at Phari Dzong, from Colonel Howard Bury:

> The route to the summit of Mount Everest by the northeast arête has been found to be practicable.
>
> On September 22, six members of the expedition, with 26 coolies, arrived at the col at the head of the Kharta valley, camping at 22,500 feet.
>
> On the following day, Mallory, Bullock and

Wheeler encamped on the glacier below the north col.

On the 24th they ascended the north col, connecting Everest with the north peak, to 23,000 ft., finding the northeast arête quite possible, but they were driven back by a furious northwesterly gale, lasting four days, with intense cold, and making all climbing impossible.

All the party are in good health. The reconaissance of Mount Everest is now completed.

The *Times* writes:

The expedition started from Darjeeling on May 18 and 19, and, taking its way through the switchback mountains of Sikkim, entered Tibet and then made westward to Tingri Dzong—north-northwest of Everest, which place was made the base for the exploration of the north and northwestern faces of the mountain. The utmost care had been taken in the fitting out of the expedition, but transport difficulties soon developed, for the mules supplied by the Indian Government broke down completely. Fortunately, Colonel Howard Bury was able to supply this deficiency locally.

The work of exploring the northwest approaches to Everest began on June 23, and on July 3 Messrs. Mallory and Bullock succeeding in climbing a peak over 23,000 ft. high. But means of ascent of Everest itself on this side proved utterly lacking—terrible precipices, descending 10,000 ft. on to a huge glacier, blocked the way. Even supposing that the rock summits at 20,000 ft. were gained—which seemed just possible—hard rock-climbing for the remaining 4,000 ft. was out of the question at that altitude.

As the north and west approaches had proved impracticable, camp was moved up Kharta at the end of July, and August devoted to reconnoitering the east side of the mountain. Here, again, disappointment awaited the climbers, for, as on the north and northwest, the eastern approaches were found to be guarded by huge precipices.

As a last resort the climbers then determined to follow up the Kharta-Tsangpo, a glacier stream, to its source, and it is in this direction that success has at length been obtained. A reconaissance early in August had shown the climbers a hitherto unknown valley which seemed to offer a practical route, and they reached a col nearly 23,000 ft. up looking on to the north ridge of Everest. The weather, however, had broken, and the climbers had to return to Kharta for a rest. They left Kharta again on August 31, and the telegram received to-day from Colonel Howard Bury tells of the happy ending to their endeavours.

Apart from this discovery of a way up the mountain, over 9,000 square miles of new territory have been surveyed.

THE LABORATORY OF THE MIAMI AQUARIUM ASSOCIATION

Students of marine life and especially those interested in fishes will be gratified to know of the establishment of a seaside laboratory by the Miami Aquarium Association at Miami Beach, Florida. The laboratory occupies the second floor in the south wing of the aquarium building and has accommodations for about ten investigators. It is provided with running fresh and salt water, with the usual laboratory outfit, and with reagent and photographic rooms. Materials for study are abundantly supplied from the large stock of the aquarium and from the neighboring waters. The aquarium runs a fleet of collecting boats including gasoline launches and three sea-going vessels: the *Allisoni,* moved by sail and gasoline, provided with live wells, and adapted to cruises of several days' length; *L'Apache,* a seventy-foot cruiser; and the *Sea Horse,* an eighty-five-foot, high-power cruising yacht just put into commission. In this way collecting trips may be made to the shoals in Biscayne Bay, the reefs in the open ocean, the Gulf Stream three miles distant, and to the Florida Keys and the Bahamas.

During a sojourn at the laboratory from the latter part of last May till the middle of July a great variety of interesting forms were met with. *Physalia,* the Portuguese man-of-war, with its symbiotic fish *Nomeus,* was abundant in the shore waters. During the latter part of June it was actively reproducing. At the same time the large rhizostomous jelly-fish *Stomolophus* was to be seen in great numbers off the coast. On the bank in Biscayne Bay the spiny sea-urchin *Diadema* and the giant conch *Strombus* were common. Spiny lobsters were always obtainable in great numbers. During July the eggs of the loggerhead turtle were hatching and sets of these were brought into the laboratory and studied there. But above all the region is immensely rich in the great variety of its highly colored, tropical fishes.

These include the various kinds of angel-fishes, parrot-fishes, snappers, trunk-fishes, morays, barracudas, sea-horses, etc., and are most beautifully exhibited in the tanks of the aquarium. But much remains to be done in ascertaining what is available in the local fauna, and the director of the aquarium has already taken steps to carry out a preliminary biological survey of the region about Miami.

The aquarium is situated on the bay side of Miami Beach at the east end of the new causeway connecting the beach with the city of Miami. A line of electric cars crosses the causeway and makes the run in either direction in about twenty minutes. Hence a person working at the laboratory may reside either in Miami, the fourth largest city in Florida, or at Miami Beach, where sleeping apartments and bungalows may be had and where there are ample restaurant accommodations. Those who want particular information about the laboratory should apply to the director, Mr. L. L. Mowbray, Miami Aquarium, Miami Beach, Florida.

G. H. PARKER

HARVARD UNIVERSITY

THE TORONTO MEETING OF THE AMERICAN SOCIETY OF ZOOLOGISTS

THE executive committee of the American Society of Zoologists has decided to present at the meeting of the society at Toronto, Canada, December 28–30, 1921, a symposium program on the general subject of "Orthogenesis," broadly interpreted, the object being to bring into the discussion as many of the newer aspects from the varied fields of the natural and physical sciences as may be feasible. The speakers the committee have invited to address the society and the subjects of each speaker are as follows; several are still in the tentative stage, as indicated:

Professor L. J. Henderson, Harvard University, "Orthogenesis from the standpoint of the biochemist;" speaker to suggest an opener for the discussion. The speaker who has been invited is at present abroad.

Professor C. B. Lipman, University of California, "Orthogenesis in bacteria;" speaker to suggest an opener for the discussion.

Professor M. F. Guyer, University of Wisconsin, "Orthogenesis in serological reactions."

Professor Wm. Bateson, of England, discussion by Dr. O. C. Riddle, Cold Spring Harbor, Long Island, New York. Title not yet received.

Professor W. M. Wheeler, Harvard University, "Orthogenesis in ants;" discussion by Professor H. C. Crampton, Barnard College, New York City.

Professor H. F. Osborn, Columbia University, New York City, "Orthogenesis as observed from paleontological evidence beginning in the year 1889;" discussion by Dr. J. C. Merriam, Carnegie Institution.

CHARLES A. KOFOID,
President

SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held at the University of Chicago on November 14 and 15.

THE thirty-ninth stated meeting of the American Ornithologists' Union will convene in Philadelphia, at the Academy of Natural Sciences, from November 8 to 10.

THE Berzelius medal has been conferred on Professor E. Abderhalden, director of the physiological institute of the University of Halle, for his research on the defensive ferments and in other lines of biologic chemistry.

MR. A. CROMMELIN, assistant astronomer of the Royal Observatory at Greenwich, has been awarded the Ponthecoulant Prize of the Paris Academy of Sciences in recognition of his general astronomical work.

PRESIDENT HARDING has appointed Dr. John Glover South, of Frankfort, former president of the Kentucky State Medical Association, as minister to Panama.

JAMES A. CRAWFORD left his position with the Buffalo Botanic Gardens on October 1 to accept an appointment as assistant curator at the New York Botanical Garden.

GEORGE M. ROMMEL, now chief of the division of animal husbandry of the Bureau of Animal Industry, United States Department of Agriculture, became editor-in-chief of the publications of the American International Publishers of New York, beginning on November 1. These include *The Field Illustrated;*

System on the Farm; El Campo Internacional, and *The Field Year Book.*

Mr. Alfred Chaston Chapman, F.R.S., president of the Institute of Chemistry of Great Britain and Ireland, has been appointed a member of the British Royal Commission on Awards to Inventors, in the room of Sir James Johnston Dobbie, D.Sc., F.R.S., resigned.

It is announced that the Colonial Office of Great Britian is organizing an expedition for research on the serotherapy of sleeping sickness in Africa. The research is to include both men and animals, and plans for a two years' stay. The expedition is in charge of Drs. Marshall and Bassolo of the Uganda Public Health Service, with two assistant physicians and two veterinarians.

The University of Toronto through its deparment of biology is developing a plan for the systematic study of the inland waters of Ontario. The work will be chiefly economic in outlook and will be under the supervision of Professor B. A. Bensley. A field party in charge of Professor W. A. Clemens spent the past summer on Lake Nipigon.

Dr. R. P. Hibbard, associate professor of plant physiology at the Michigan Agricultural College and plant physiologist at the Michigan Agricultural Experiment Station, has been granted leave of absence for the current year in order to accept a Johnston scholarship in the Johns Hopkins University. He is engaged in research in the laboratory of plant physiology.

The first meeting for the session 1921–1922 of the Chicago Institute of Medicine was held October 21, when the Pasteur lecture was delivered by Dr. Theobald Smith on "Theories of Susceptibility and Resistance in Relation to Methods of Artificial Immunity."

Dr. Réné Ledoux Lebard, of Paris, addressed the historical section of the New York Academy of Medicine on October 13. The subject of his paper was "Color Print Illustration of Medical Books up to the Year 1800."

Sir Harold J. Stiles, of Edinburgh, delivered the Wesley M. Carpenter Lecture before the New York Academy of Medicine on the evening of October 20. His subject was "Surgical Tuberculosis in Children and Its Relation to the Milk Problem." On October 14 he delivered a Mayo Foundation lecture, "The history of medicine in Edinburgh."

Professor Charles Baskerville, of the College of the City of New York, lectured on "Science and Civilization; the Rôle of Chemistry," at the joint meeting of the Technical Societies and the Rhode Island Section of the American Chemical Society, at Providence on October 18.

Sir W. J. Pope, president of the British Society of Chemical Industry, lectured before the Congress of Industrial Chemistry recently held in Paris on the future of organic chemistry, with special reference to the advantages which France and Britain might derive from their tropical possessions. Sir William Pope spoke at the annual dinner of the British Society of Chemical Industry when he referred to the recent visit of delegates of the society to Canada and the United States.

Nature states that Charles Darwin's birthplace, known as The Mount, Shrewsbury, situated in that part of the town known as Frankwell, has been purchased by H. M. Office of Works. The house was built about 1800, and at the time when Sir Francis Darwin wrote, in 1887, "The Life and Letters of Charles Darwin," it had undergone but little alteration. It was "a large, plain, square, red-brick house, of which the most attractive feature" was "the pretty greenhouse, opening out of the morning-room."

Professor Alexander Gray, director of the school of electrical engineering at Cornell University, died at his home in Ithaca on October 13.

The death is announced of Dr. M. H. Fussell, professor of applied therapeutics in the University of Pennsylvania and a member of the committee on revision of the U. S. Pharmacopeial Convention.

THE death is announced of Emile Houzé, professor of anthropology at the University of Brussels and at the École d'Anthropologie of that city.

WE regret to record the death of Seymour C. Loomis, Esq., who while practicing law at New Haven long served the American Association for the Advancement of Science as secretary of the section of social and economic sciences.

THE 111th regular meeting of the American Physical Society will be held in Chicago, at the Ryerson Physical Laboratory, on Saturday, November 26. If the length of the program requires it, there will also be sessions on Friday, November 25. Other meetings for the current season are as follows: December 27–31, Toronto: annual meeting. February 25, New York. April 22, Washington.

A PUBLIC meeting under the auspices of the New York sections of the four national engineering societies on the subject of "the St. Lawrence Ship Canal and Power Project" will be held in New York City on November 14.

THE annual meeting of the American Philosophical Association will be held on December 28, 29, and 30, at Vassar College, Poughkeepsie, N. Y. The meeting will open with an informal smoker on Wednesday evening. On Thursday morning and afternoon and Friday morning the sessions will be devoted to the reading and discussion of papers. The annual dinner, followed by the address of the president, will be held on Thursday evening.

WE learn from *Nature* that the number of ordinary scientific meetings of the London Chemical Society to be held during the coming year has been increased with the object of affording greater facilities for papers to be read before the society. The first meeting was held at Burlington House on October 6. Following the custom of the last few years, the council has again arranged for the delivery during the session of three special lectures which, by the courtesy of the council of the Institution of Mechanical Engineers, will be held in the lecture-hall of that institution. The first, entitled "The genesis of ores," will be delivered by Professor J. W. Gregory on December 8. On February 9, Sir Ernest Rutherford will lecture on "Artificial disintegration of elements"; while the last lecture, by Dr. H. H. Dale, entitled "Chemical and physiological properties," will be given on June 8.

THE *Journal* of the American Medical Association reports that an appropriation of $16,000,000 for the construction of additional hospital facilities to provide medical, surgical and hospital services for former service men is contained in a bill introduced by Representative Langley of Kentucky, chairman of the House Committee on Public Buildings and Grounds. The money is supplementary to the $18,500,000 appropriated at the last session of Congress, the total of which has already been disbursed with the exception of $1,339,000. In the new Langley measure $15,500,000 will be used for hospitals and extensions to present facilities to be distributed under the supervision of the Secretary of the Treasury. The other $500,000 carried by the bill will be assigned to the purchase of additional land and for the erection of new buildings at the Mount Alto institution. Representative Langley presented his bill after extensive conferences with representatives of the Treasury Department and with officials of the American Legion.

THE prevalence of foot and mouth disease in some countries in Europe, in certain parts of Asia and Africa, as well as in South America, has caused the United States Department of Agriculture to institute special quarantines against the importation of live stock from these places. Any one who wishes to import cattle, sheep, goats, swine or other animals from any country, except Canada or Mexico, must first obtain from the Secretary of Agriculture a permit, to be presented to the American consul at the port from which the animals will be shipped. No permits are issued for shipment from countries where rinderpest, surra, foot and mouth disease, or contagious pleuro-pneumonia exist. Foot and mouth disease prevailed to a serious extent in England during the last two years, but recently has been abated to the extent that horses from both England and Ireland

are now allowed to enter the United States if certain restrictions regarding feeding and care are observed.

The 158th meeting of the Washington Academy of Sciences was held at the Public Library, October 20. The meeting was devoted to a discussion of popular and readable books in science. After informal talks by Dr. G. F. Bowerman, librarian of the Public Library, and by several members of the committee appointed to select the list of "one hundred popular books in science," an opportunity was given to examine the books themselves and to discuss them informally. In addition to the selected list of 100, there was a second exhibit consisting of books suggested for the popular list, but not used, and the members of the committee were invited to criticize their choice and suggest substitutions or additions, in order that the best possible list might be prepared for distribution by the librarian. A third exhibit consists of readable manuals or information-books which workers in one branch of science can recommend to workers in other branches or to readers seeking general information on a given subject. Suggestions as to improvements and additions to this list were also invited.

The department of botany of the State College of Washington has increased its herbarium by the acquisition of the recent collections of Mr. James R. Anderson, the veteran Canadian botanist of Victoria, B. C. His herbarium comprises 2,600 mounted sheets of the higher plants, coming from all over British Columbia. The majority of the specimens are from Vancouver Island, but there are also considerable numbers from the humid coastal strip of the mainland, others from the dry belt east of the Cascades, and others from the high Rockies.

The Iowa Child-Welfare Research Station at the State University has organized a Laboratory in Child Psychology for experimental work with children from two to four years of age. A new four-room building has been constructed, and 24 children are now in attendance daily, in two sections from 9 to 12 o'clock. The laboratory is under the immediate direction of Dr. Bird T. Baldwin, research professor in psychology, and Dr. Lorle I. Stecher, research assistant professor, with graduate student assistants.

The Polish National Museum of Natural History has been formed by a union of the Branicki Zoological Museum and the Zoological Museum of the University of Warsaw.

The New York Zoological Park has made a presentation of a number of reptiles to replace those in the Jardin des Plantes, Paris, which had to be destroyed during the war. The gift includes two boa constrictors, six alligators, and sixteen turtles.

A prize of £20,000 is being offered by the French Aeronautic Propaganda Committee to the constructor of a motor for commercial aviation which shall best satisfy the tests of a special competition, including durability, regularity and simplicity.

A special faculty research committee has been organized at Oberlin College to cooperate with the "National Research Council." Dr. S. R. Williams, head of the department of physics, is chairman, while other members of the committee include members of the departments of mathematics, sociology, psychology, chemistry and geology.

Dr. Wm. Curtis Farabee, president of the American Anthropological Association, has returned to his work at the University of Pennsylvania. During the summer he attended the Centennial Celebration at Lima, Peru, as one of the special mission appointed by President Harding. The Lima Scientific Society held a special meeting in Dr. Farabee's honor and elected him a corresponding member. All members of the Mission were elected to the ancient order "El Sol de Peru." The commission, composed of the Honorable Albert Douglas, General Hunter Liggett, Admiral Hugh Rodman, Colonel Wm. Boyce Thompson, Honorable Wm. Heimke and Dr. Wm. Curtis Farabee, sailed from New York on three U. S. battleships, the *Arizona, Oklahoma* and *Nevada,* under command of Admiral John McDonald.

Mr. George D. Hubbard, professor of geology at Oberlin College, has returned from a

year of travel and study in the Hawaiian Islands, Japan, Korea and China. He spoke at the government colleges for teachers in Peking, and at other schools in China. The report of his work, which is the most detailed study made to date, of the valley of the Min river in the borderland of Thibet, some 300 miles beyond Cheng Tu, will be published by the government geological survey of China. Mr. Hubbard is also preparing papers on the copper mines near Cheng Tu worked by the Chinese, on the antimony mines at Kwang Tung, near Canton, on the physiographic history of the Yang Tse river, and on the geography of some of the Chinese rivers. The copper mines at Asieo, Japan, will be the subject of a paper. Mr. Hubbard is planning two books based on the year's study; a book on the development of the mineral resources of China, and a book on the geography of China for use in Chinese schools.

UNIVERSITY AND EDUCATIONAL NEWS

DEAN HENRY P. TALBOT, of the department of chemistry of the Massachusetts Institute of Technology, and Dr. William H. Nichols, of New York, made addresses at the dedication of the new Steele Chemistry Building at Dartmouth College, on October 29.

PROFESSOR ARTHUR M. GREENE, JR., head of the mechanical engineering department at Rensselear Polytechnic Institute, at Troy, N. Y., has been appointed dean of the School of Engineering of Princeton University.

PROFESSOR A. V. MILLER, associate professor of drawing and descriptive geometry, has been appointed assistant dean of the college of engineering of the University of Wisconsin to take the place of Professor J. D. Phillips who is now acting business manager of the university.

AT the Detroit College of Medicine and Surgery Dr. Donald Beaver, formerly of the pathologic department of the University of Minnesota has been appointed assistant professor of pathology, Dr. Paul Wooley, former professor of pathology in the University of Cincinnati, associate professor of pathology and pathologist to the Herman Keiffer Hospital, Detroit.

DR. SERGIUS MORGULIS has been appointed professor of bio-chemistry and Dr. George A. Talbert assistant professor of physiology in the College of Medicine, University of Nebraska, Omaha.

DR. M. J. DORSEY, for ten years in charge of the section of fruit breeding of the department of horticulture of the University of Minnesota, has been elected head of the department of horticulture of the West Virginia University and the West Virginia Agricultural Experiment Station, to succeed Professor J. H. Gourley.

HENRY SCHMITZ AND C. EDWARD BEHRE, of the school of forestry, University of Idaho, have been advanced, respectively, to the rank of associate professors of forest products and of lumbering.

DISCUSSION AND CORRESPONDENCE

AERIAL OBSERVATION OF PHYSIOGRAPHIC FEATURES

THE article on "Aerial observation of earthquake rifts" published by Professor Bailey Willis in SCIENCE for September 23, 1921, prompts me to add a word to his interesting discussion. During the war I had occasion to make a short aeroplane flight over the harbor of Valona for the purpose of studying the natural topographic defenses of that strategic key to the southern Adriatic Sea. The ascent was made in the late afternoon, when strong shadows brought out most distinctly the relief of the terrain. It was to me a matter of some surprise to find that physiographic features which were so poorly represented on the inadequate maps of the region as scarcely to betray their presence, or at least their true character, appeared with surprising distinctness when seen from the plane. In particular, certain abandoned shorelines, now left some distance inland by the prograding of the shore, and which I had failed to observe in brief excursions by automobile about the harbor, suddenly stood out with all the clearness of a diagram. The es-

sential characteristics of the mountain ranges of this part of Albania were much more easily observable than from the ground, while something could also be determined about the form of the seaward extension of the land under the shallow marginal waters of the Adriatic, especially as to the submarine extension of delta and beach deposits.

In an aeroplane flight from Paris to London this past summer I was again impressed with the potential value of the aeroplane in physiographic reconnaissance. The surface of northern France is of very moderate relief, yet when flying low it was much easier to observe many critical features and to note their broader relationships than would have been the case from selected points on the ground. The excellent topographic maps of this region render aerial observation less necessary than in countries where maps are poor in quality, or wholly lacking; but there can be no doubt of the value of such observation in supplementing map studies and ordinary field work on the ground. On both the French and English shores of the English Channel shoreline phenomena such as cliffs, beaches, dunes, deltas, and submarine bars not only were remarkably distinct, but their relations to surrounding features appeared with a clearness observable in no other manner. Certainly the large scale British maps of the Dungeness foreland, excellent as they are, give no such vivid impression of the evolution of that wonderful series of beach ridges as comes to one who looks down on the foreland from an aeroplane flying at an altitude of a few thousand feet. In the late afternoon the unroofed dome of the Weald had all the distinctness of a relief model, with the oval pattern of its infacing cuestas or hogbacks readily distinguishable.

In the detailed work of tracing specific peneplane levels across mountainous country one not infrequently encounters the difficulty that in critical areas where observations are much needed the only effective viewpoints are rendered useless by a dense forest cover; or one may climb a selected peak only to find that it is not at the proper elevation to give the best results. Good field observations may be of vital importance, not merely as a check on profile studies based on topographic maps, but also because the limitations of the profile method are such that not infrequently proper field observation alone can settle doubtful points. It has occurred to me that in studies of this nature either the captive balloon or aeroplane could be used to good effect. Map studies, where possible, will define the limits of the problems to be settled in the field, and indicate the places where evidence of decisive value can most probably be secured by satisfactory observations. A few hours in captive balloon or aeroplane under these conditions might prove of more value than weeks of inconclusive work on the ground.

Douglas Johnson
Columbia University

SCIENTIFIC LITERATURE IN EUROPEAN COUNTRIES

The lead taken by the Biological Club of the University of Minnesota should certainly be followed by many other scientific groups or individuals, according to their ability. Such arrangements as Dr. Barker describes not only promote the interests of science, but also aid materially in bringing about that international good-will and cooperation which this world so sorely needs. After a visit to Europe one returns with the conviction that if the psychological difficulties could be overcome, it would not take very long to restore material prosperity. Could Europe somehow be endowed with a genuinely scientific spirit, combined with general good will, the fearful situation which now exists might well give way to a new epoch compared with which the past would seem like a bad dream.

During the winter I was in Portugal and the Madeira Islands, I found that the escudo, formerly having the value of a dollar, was rapidly diminishing in exchange value. On arriving in Madeira in December, I got 28 for an English pound. When I left, in March, the exchange was fluctuating between 45 and 50 to the pound. I met a very able and enthusiastic

naturalist in Funchal, who was handicapped at every turn by the lack of literature. He had purchased what he could, but at present prices were prohibitive. The Madeira Islands are extraordinarily interesting to the biologist, and every encouragement should be given to those who would study the fauna, flora or geology. Why should not we place a good series of American publications in the public library (Biblioteca Municipal) of Funchal, where they would be available to students? Anything sent there, care of the librarian, Sign. A. C. de Noronha, will be appreciated. There is, however, another very important way in which we can render assistance. That is by subscribing to European scientific journals, or joining scientific societies. In doing this, we enrich ourselves. The gallant way to which the scientific home fires have been kept burning in certain quarters would command our admiration if we knew the facts. Take for instance the *Annals and Magazine of Natural History*, the leading zoological journal of England. It appeared regularly all through the war, though the staff of the printing office (Taylor and Francis) was reduced to a minimum. It publishes zoological papers more promptly and accurately than any journal in America. Not long ago I presented a paper on fossil insects, with over 50 figures, and it appeared within a few months. I was not asked to pay for the cuts, as one often is in America, sometimes at fancy prices. The obvious comment would be, that the Annals must be a prosperous concern, quite unlike our poor American journals. On the contrary, I happen to know that it is losing heavily, but it carries on. There are many such cases, I do not doubt.

T. D. A. COCKERELL
UNIVERSITY OF COLORADO

SCIENTIFIC BOOKS

Sturtevant's Notes on Edible Plants. Edited by U. P. HEDRICK. Report of the New York Agricultural Experiment Station for the year 1919, II. Albany, J. B. Lyon Co., State Printers, 1919. 4to. Pp. i–vii, 1–686, with portrait.

A work of more than usual note has been made available to students of agricultural botany by the publication of a selected portion of the data on edible plants brought together by Dr. E. L. Sturtevant, first director of the New York Agricultural Experiment Station. Over six hundred quarto pages comprise the body of the volume, to which are added bibliography, index, biographical sketch of Dr. Sturtevant by Dr. Hedrick, editor's preface, Director W. H. Jordan's letter of transmittal, and a full-page portrait. The entries are arranged alphabetically under the Latin name of the plant to which reference is made. The first entry is here reproduced to give an idea of the manner in which the material is presented.

Aberia caffra Harv. & Sond. *Bixineae.* KAI APPLE. KAU APPLE. KEI APPLE.

South Africa. The fruits are of a golden-yellow color, about the size of a small apple. They are used by the natives for making a preserve and are so exceedingly acid when fresh that the Dutch settlers prepare them for their tables, as a pickle, without vinegar. Jackson, J. R., *Treas. Bot.* 2: 1255. 1876.

The closing citation is not attached to the paragraph as shown here, but is dropped to the bottom of the page, taking the form of a footnote. When mention of a synonym is required it follows the citation at the bottom of the page. Many of the entries are only of a few lines each, some of them range up to a page or two, while about two dozen entries occupy more space. About three pages each are given to Lima bean, English bean, pea, egg plant, cucumber, watermelon, kale, parsley, and wheat; four pages each to artichoke, carrot, onion, and radish; five pages each to banana, currant, cabbage, turnip, tomato and muskmelon; six pages each to beet, common or field bean, potato and pepper; eight pages to strawberry; and twelve pages to squash and pumpkin, and to corn. To secure the data, Dr. Sturtevant, who had a good reading acquaintance with Latin, Greek, French and German, and some knowledge of other languages, accumulated an extensive library, especially rich in pre-Linnaean works, and abounding in rare issues.

The underlying idea of the work is to supply data on the history of edible plants whether accounted of little or much value, and especially regarding their early uses in all parts of the world by primitive peoples and others, and to trace their introduction into cultivation, and their expansion into varieties as known at the present time. In these respects he has greatly added to the knowledge available in DeCandolle's "Origin of Cultivated Plants," Pickering's "Chronological History of Plants," and other standard works on the history of esculents.

The wealth of material brought together may to some extent be judged from the fact that DeCandolle's work, generally considered the best available on the history of cultivated plants, treats scarcely of 250 kinds, while the present work embraces nearly 3,000 kinds. The work is, moreover, only the choicest part of a vast storehouse of information secured by Dr. Sturtevant, which he would undoubtedly have elaborated into a still more extensive work, had it not been for his premature death. The extent of the research involved, a specially valuable portion being the knowledge obtained from rare and obscure writings, can be inferred from there being upwards of 6,000 citations, referring to some 500 publications.

But the work is not simply that of a bibliophagist and collector of data, for Dr. Sturtevant was a life-long student of constancy and variation in both plants and animals. As joint proprietor with his brothers of Waushakum Farm and Director of the New York Agricultural Experiment Station he possessed great opportunities for direct observations, which his keen and richly endowed mind combined with energy and initiative utilized to fullest degree. This practical knowledge has insured the omission of improbable travellers' tales and fanciful myths, and made the entries as scientifically historical and accurate as is possible.

Large credit must be given for preparing and issuing this volume to the broad-visioned director of the station at Geneva, Dr. W. H. Jordan, who authorized its preparation, and to the editor, Dr. U. P. Hedrick, who has shown in the arrangement of its contents a fine knowledge of the subject, rich scholarship and unflagging zeal. It was necessary for Dr. Hedrick to select the material from a vast amount of manuscripts, notes, and card catalogue items that had lain in the station library for twenty years, and to verify and complete the long list of citations. He has also supplied a very full and sympathetic account of Dr. Sturtevant's scientific career. The writer of this notice was associated with Dr. Sturtevant during the larger part of his directorship, and can therefore more fully realize the extent and value of the original material and of the labor expended upon it by the editor.

J. C. Arthur

Purdue University,
Lafayette, Indiana

SPECIAL ARTICLES

THE DISPLACEMENT METHOD FOR OBTAINING THE SOIL SOLUTION[1]

There have been several methods proposed for obtaining the soil solution. Among the most promising of the methods are those which depend upon the principle of the displacement of the soil solution by another liquid. Schloesing[2] was probably the first to use the displacement method, using water as the displacing liquid. Istcherekov[3] used ethyl alcohol as the displacing liquid and obtained results indicating that the true soil solution was secured. Morgan[4] has modified the displacement method, using a heavy oil as the displacing liquid and applying pressure to force the oil into the packed soil.

The present investigation was suggested by the work of Istcherekov, and the procedure followed was essentially the same as used by that investigator. Several displacing liquids were tried, including those miscible and non-miscible with water. The most satisfactory results were secured by use of ethyl alcohol.

The method consists of packing the moist

[1] Published with the permission of the Director of the Wisconsin Agricultural Experiment Station.

[2] *Compt. Rend. Acad Sci. Paris*, 63, 1007 (1866).

[3] *Jour. Exp. Landw.* (Russia), 8 (1907).

[4] Mich. Agr. Exp. Sta. Tech. Bul. 28 (1916).

soil in a cylinder provided with an outlet at the bottom. The ethyl alcohol is then poured on top of the soil column and as it penetrates the soil it displaces some of the soil solution which forms a zone of saturation below the alcohol. This zone increases in depth as it is continually forced downward by the alcohol. When the saturated zone reaches the bottom of the soil column the soil solution, free of alcohol, drops from the soil as gravitational water.

The only apparatus required is a cylinder in which to pack the soil. Brass soil tubes or glass percolators were used for this purpose. The diameter of the tube and the height of the soil column determine the rate and time required for displacement.

The soil was packed in the cylinders by means of a short wooden rod. No difficulty was experienced in obtaining uniform packing. The degree of packing required for the best results is determined by the kind of soil and its moisture content. Sands and peats can be packed very firmly, but with heavier soils care must be taken that they are not puddled in packing, in which case displacement is exceedingly slow or entirely prevented. To prevent puddling it is best to use the heavier soils at moisture contents slightly below their optimum for plant growth. After a little experience one can readily determine the proper degree of packing for any soil at a given moisture content.

The time required for displacement varies widely depending on the moisture content of the soil, the degree of packing, the soil type, and the height of the soil column. In most cases it is possible to complete the displacement in one day, often in a much shorter time, if the soil column is not over twelve to fifteen inches in height. However, in some cases it required several days to complete the displacement.

It is practicable to obtain 35 to 45 per cent. of the soil solution by this method. However, it is possible to displace a much larger percentage of the soil solution than this. Using a silt loam soil at a moisture content of 23.3 per cent. a 75.6 per cent. displacement has been secured. Istcherekov reports that with a soil at saturation it is possible to displace about 95 per cent. of the soil solution before the appearance of alcohol.

The method has been successfully used on a number of soils including sands, loams, clays and peats. The results obtained indicate that the true soil solution is secured. Successive portions of the displaced solution have the same composition as is indicated by total salt and freezing point determinations. It is probable that the solution obtained is a true aliquot of the entire soil solution, that is, the displaced solution is of the same composition as the portion remaining in the soil. A comparison was made of the amount of total salts and nitrates obtained by the displacement method and by a 1 : 5 water extraction of the soil. The results given in Table I. shows that the two methods give approximately the same amount of total salts. The results for nitrate nitrogen are the same within experimental error.

TABLE I

Total Salts and Nitrate Nitrogen in the Dry Soil as determined by the Two Methods

	NO_3		Total Salts	
Kind of Soil	P.P.M. Water Extract	Nitrogen Displacement	P.P.M. Water Extract	Displacement
Clay loam	71.5	75.2	796	747
Clay	29.4	24.7	370	306
Sand	18.7	22.4	205	275
Sand	57.0	61.2	1,400	1,512
Silt loam	10.8	9.7	223	161
Silt loam	79.8	71.0	732	648
Silt loam	48.3	54.5	506	512

Although the displacement method has received only slight recognition, the writer believes it has many possibilities. It seems to offer an opportunity for a more careful study of the concentration, composition, and reaction of the soil solution. A more complete knowledge of the changes that take place in the soil solution should aid in the solution of many of the problems of the soil fertility, plant nutrition, and related subjects.

F. W. PARKER

UNIVERSITY OF WISCONSIN

THE AMERICAN ASTRONOMICAL SOCIETY

The twenty-sixth meeting of the society was held from August 30 to September 1, 1921, at Wesleyan University, Middletown, Connecticut. The attendance was the largest in the history of the society, more than one hundred members and guests being present. The visitors were housed in the college dormitories and had meals in common in one of the fraternity houses. Among the social events were a reception at the Van Vleck Observatory by Dr. and Mrs. Frederick Slocum, tea at the home of President and Mrs. Shanklin, a motor ride, hike, and a boat trip on the Connecticut River.

The sessions on three days were taken up by the reading of papers and committee reports. The eclipse committee gave complete information in regard to possible sites for the total solar eclipse in Australia on September 21, 1922, and reported progress on investigating the conditions for the eclipse in lower California and Mexico on September 10, 1923. There is promise that opportunity will be taken at both of these eclipses to verify the Einstein effect which was first observed at the eclipse in 1919.

Twenty new members were elected to the society, bringing the total membership of the society up to 370. The society elected to honorary membership Professor C. W. L. Charlier of the University of Lund.

Officers for the ensuing year are as follows:

President—Frank Schlesinger.

Vice-presidents—Otto Klotz and John A. Miller.

Secretary—Joel Stebbins.

Treasurer—Benjamin Boss.

Councilors—Philip Fox, Caroline E. Furness, A. O. Leuschner, Henry Norris Russell, V. M. Slipher, Frederick Slocum.

In view of the increasing interest taken in the gatherings of the society, it was decided to have two meetings during the next year, the first to be held in Christmas week in 1921 at a place not yet determined.

The program of papers was as follows:

On the correlation of wave-length with spectral type and absolute magnitude: Sebastian Albrecht.

The number and distribution of novæ: S. I. Bailey.

New measures of solar activity and the earth-effect: Louis A. Bauer.

Notes on the early evolution of the reflector: Lewis Bell.

On the real motions of the stars: Benjamin Boss, Harry Raymond, and Ralph E. Wilson.

The Trojan group of asteroids: Ernest W. Brown.

Peculiar spectra in the large Magellanic cloud: Annie J. Cannon.

Gilbert's bombardment hypothesis: Julian L. Coolidge.

The amplitude of the light-variation of δ Cephei: Ralph H. Curtiss.

The spectrum and radial velocity of Comet 1913 f (Delavan): Ralph H. Curtiss and Dean B. McLaughlin.

The parallax of Nova Aquilae No. 3: Zaccheus Daniel.

Spectroscopic measurements of the solar rotation in 1915: Ralph E. De Lury and Jean Edouard Belanger.

Displacements of lines in spectra of spots situated at various distances from the center of the solar disc: Ralph E. De Lury and J. L. O'Connor.

Dark nebulæ in the Orion and Sagittarius regions photographed with the 100-inch Hooker telescope: John C. Duncan.

Note on the parallaxes of stars with large proper motion: F. W. Dyson.

The mass of Neptune: W. S. Eichelberger and Arthur Newton.

The probable absence of a measurable electric field in sun-spots: George E. Hale.

Mars 1920: George Hall Hamilton.

The spectroscopic system of σ Scorpii: F. Henroteau.

Some remarks on Cepheid variables: Frank C. Jordan.

A remarkable meteor trail: Frank C. Jordan and Keivin Burns.

Approximate orbit and absolute dimensions of S Antliæ: Alfred H. Joy.

Some recent results in photographic photometry: Edward S. King.

Notes on observations of nebulæ: C. O. Lampland.

A computation of the solar motion from the radial velocities, proper motions, and spectroscopically determined parallaxes of 762 stars: E. S. Manson, Jr.

The orbit of ζ Centauri. Preliminary note on ν Sagittarii: Antonia C. Maury.

Progress in radial velocity observations of long-period variables: Paul W. Merrill.

Parallaxes of seventy-three stars: John A. Miller.

The new electric driving clock of the photographic telescope of the U. S. Naval Observatory: George Henry Peters.

Preliminary parallax of the Pleiades: John H. Pitman.

The intensity distribution in the solar spectrum: H. H. PLASKETT.

The spectroscopic orbit and dimensions of TV Cassiopeiæ: J. S. PLASKETT.

The radial velocities of 594 stars: J. S. PLASKETT, W. E. HARPER, R. K. YOUNG, and H. H. PLASKETT.

A probable influence of the earth on the formation of sun-spots: LUIS RODÉS.

The relation between the diameter of a photographic star image and its magnitude: FRANK E. ROSS.

Systematic corrections and weights of catalogs. An addition to Appendix III of Boss's Preliminary General Catalog: ARTHUR J. ROY.

Orbits of three spectroscopic binaries: R. F. SANFORD.

Phenomena in connection with our transit of the plane of Saturn's rings in 1920–1921: E. C. SLIPHER.

Further notes on spectrographic observations of nebulæ and clusters: V. M. SLIPHER.

Some recent results of plate tests at the Harvard Astronomical Laboratory: HARLAN TRUE STETSON.

The diurnal variation of clock rates: R. H. TUCKER.

The Elgin Observatory: FRANK D. URIE.

Progress in the chronographic registration of radio time signals: FRANK D. URIE.

The San Diego Radio Time Signals: FRANK D. URIE.

Internal motion in four spiral nebulæ: ADRIAAN VAN MAANEN.

Atomic structure: FRANK W. VERY.

Solar hot-box studies: FRANK W. VERY.

Observations of 12 Lacertæ, 1919, 1920, 1921: R. K. YOUNG.

Orbit of the spectroscopic binary Boss 5442: R. K. YOUNG.

JOEL STEBBINS,
Secretary

NEW YORK MEETING OF THE AMERICAN CHEMICAL SOCIETY

DIVISION OF BIOLOGICAL CHEMISTRY

Arthur W. Dox, *Chairman.*
Howard B. Lewis, *Secretary.*

Symposium on Vitamines

The antineuritic vitamine: CASIMIR FUNK.

Experiments on the isolation of crystalline antineuritic vitamine: ATHERTON SEIDELL.

The antiscorbutic vitamine: A. F. HESS.

Factors influencing the vitamine content of food materials: R. ADAMS DUTCHER.

Standardized methods for the study of vitamines: A. D. EMMETT. In view of the great stress that is being placed upon vitamines with respect to the etiology of certain deficiency diseases and to the relative content of various products and foods, it would seem almost imperative to follow a more definite method of procedure than is now used in carrying out the biological tests. Otherwise, it is quite conceivable, due to the many possible variables that may easily enter, that the results obtained by the workers from different laboratories may be contradictory or even misleading at times.

It is suggested, as a step in correcting this condition of affairs, that it would be well to outline definitely and in detail the various stages of the procedure so that there can be provisional methods to refer to as standards. If these are established and followed, they will serve as a guide from and to which it will be possible to correlate the results obtained when the animal diets or rations are varied in accord with the needs of the individual projects and make it easier to conclude with more definiteness the significance of the results.

Standardized methods for the study of vitamines: A. D. EMMETT.

Vitamines from the standpoint of structural chemistry: R. R. WILLIAMS.

Vitamines from the standpoint of physical chemistry: V. K. LA MER.

General Discussion—KATHERINE BLUNT, G. H. A. COWLES, and others.

The influence of the vitamine content of a feed on the nutritive value of the milk produced: J. S. HUGHES, J. B. FITCH, and H. W. CAVE. Four calves were started on the experiment; two were from cows which had received a food low in vitamine during the entire gestation period, the other two were from cows which had received normal feed. During the first week the two calves from the experimental cows received their mothers' milk. At this time one of these cows died and her calf was then given the other experimental cow's milk. The two calves from the cows receiving normal feed were fed on herd milk exclusively. All four calves wore muzzles so they could get no other feed. All the calves seemed to be normal for the first five weeks, at which time one of the calves receiving the

experimental milk became blind. It died when it was forty-two days old, showing nervous symptoms very much like an animal with beri beri. The other experimental calf became blind when seventy-eight days old and died nineteen days later with symptoms like the first. A calf from a cow receiving normal feed was placed on the experimental milk at the time the first calf died. It did not become blind but died at the end of nineteen weeks. The two calves receiving the herd milk are still normal after a period of eight weeks.

The influence of excessive oxidation upon the nutritive and antiscorbutic properties of cow's milk: R. Adams Dutcher and Clifton W. Ackerson. Eight guinea pigs, used as controls, were fed a diet of oats ad libitum and 30 c.c. (daily) of fresh raw milk from the university dairy herd. Ten guinea pigs were fed oats and milk powder (prepared from the herd milk). The milk powder was diluted back to the same composition as the original raw milk and 30 c.c. were fed daily to each animal. The milk powder was prepared at intervals of 2 to 5 days by spraying the milk into a blast of hot air in a cell four feet square. Each quart of milk came in contact with approximately 1,400 cubic feet of hot air. The air in the cell was kept at a temperature of 115° C. while the temperature at the spray nozzle never exceeded 100° C. The milk powder was allowed to remain on the floor of the cell during the drying process (2–3 hours). No attempt was made to approximate commercial conditions. The entire group of guinea pigs receiving the milk powder died with pronounced scurvy lesions in periods ranging from 16 days to 42 days. At the end of 42 days all of the control animals, which had consumed their daily ration of raw milk, were living and in much better physical condition than the group receiving the dried milk.

The relation between the vitamine content of feed and hatchability of the eggs produced: J. S. Hughes, L. F. Payne, and F. E. Fox.

A comparison of the yeast and bacteria growth promoting vitamines: Louis Freedman. It was found experimentally that beef and beef-heart infusion, peptone and autolyzed yeast contain substances which are equally active for growth of hemolytic streptococci and yeast cells. This substance was found present to a limited extent, in casein and other animal and vegetable proteins which were specially prepared and purified. The substance active for streptococci is of similar nature if not identical with the yeast growth promoting vitamine present in autolyzed yeast. There is also present in beef heart another substance, associated with blood, which is necessary for growth of streptococci. The nature of this has not yet been determined. Further work on these problems is now in progress.

The vital problem of vitamines—a plea for a vitamine institute. Food products rich in vitamines: B. Dass. Since the indication of the existence of vitamines some twelve years ago, this subject has been receiving increasing attention. The results of many investigations have proved beyond doubt the utmost importance of the presence of vitamines in foods and also have established the relative vitamine content of the various articles of food. Nowadays there are in the market quite a few food products advertised to be rich in vitamines. The necessity of such products can not be overestimated provided they are truly rich in vitamines and at the same time reasonably low in price so as to be available to the poorer classes of people who are, generally speaking, the victims of diets deficient in vitamine-content.

The distributor of vitamines in natural foodstuffs: W. D. Richardson.

Some experiments with the vitamines of autolyzed brewer's yeast. Preliminary communication: Harry E. Dubin and Casimir Funk. Pigeon and rat experiments were conducted in order to test the influence of vitamine B and the substance (called provisionally "vitamine D") promoting the growth of yeast. The above vitamines were obtained, one practically free from the other, from autolyzed yeast by means of fractional shaking with fuller's earth. The results show clearly that pigeons require vitamine B while rats require vitamine D for maintenance and growth. On vitamine D alone, after one month, pigeons have not developed beriberi, although they have lost considerable weight. On vitamine B alone, rats have consistently lost weight and present a poor physical appearance. Both pigeons and rats thrive best on a mixture of vitamines B and D.

Proof of the presence of lipase in milk and a new method for the detection and estimation of the enzyme: Frank E. Rice and Alton L. Markley. (1) Lipases are defined as enzymes which split natural fats. (2) Methods for determining lipase are not satisfactory unless the fat-substrate is well emulsified in the suspension medium, and unless a preservative is used which prevents all bacterial

growth but does not check the action of the enzyme. (3) The following method is suggested: Boiled cream of high fat content is used as substrate. Cane sugar is added in sufficient quantity to form a saturated solution with all the water present. After addition of the enzyme, the mixture is titrated at the beginning and end of a digestion period. (4) It is proved that milk normally contains lipase. (5) Lipase doubtless is a factor in the development of rancidity in seed oils, butter and cheese. (6) Direct proof is offered that sweetened condensed milk becomes rancid on account of an admixture of raw milk, the lipase therein producing the phenomenon.

A quantitative method for the determination of peroxidase in milk: FRANK E. RICE, and T. HANZAWA. (1) The method of Bach and Chodat[1] is modified for application to milk. It depends upon the oxidation of pyrogallol to insoluble purpurogallein with hydrogen peroxide, the reaction being catalyzed by peroxidase. (2) The milligrams of purpurogallein obtained per 10 c.c. of milk is taken as the "peroxidase number." (3) Since several days are necessary for the attainment of equilibrium air must be excluded from the reaction. (4) The dependence of the peroxidase number on the amount of peroxidase present was proved by making determinations on various mixtures of raw and boiled milk.

Effects of certain antiseptics upon the activity of amylases: H. C. SHERMAN and MARGUERITE WAYMAN. The influence of toluene, formaldehyde and copper sulphate upon amylases of both animal and vegetable origin was studied. Toluene had very little influence upon the activities of the amylases either in their natural or purified condition. Formaldehyde even in small amounts (0.00006 molar and less) was found distinctly injurious to all of the amylases studied, viz., commercial pancreatin, purified pancreatic amylase, saliva, malt extract, purified malt amylase, commercial takadiastase, and the purified amylase of *Aspergillus oryzæ*. Takadiastase was the least, and purified pancreatic amylase was the most, affected. All of these enzymes were also found to be very sensitive to copper sulfate. The percentage loss of enzyme activity under the influence of formaldehyde or copper was determined by the concentration of the antiseptic in the solution and not by the ratio of antiseptic to enzyme or to substrate. The results as a whole, in addition to their bearing upon the problem of quantitative distinction between organized and unorganized ferment action, are of interest in that they afford a new indication of the protein nature of these typical enzymes.

[1] *Ber. d. d. Chem. Ges.*, 37 (1904), 1342.

The influence of certain amino acids upon the enzymic hydrolysis of starch: H. C. SHERMAN and FLORENCE WALKER. Addition of glycine, alanine, pheylalanine or tyrosine caused an undoubted increase in the rate of hydrolysis of starch by purified pancreatic amylase, commercial pancreatin, saliva, or purified malt amylase. Less marked results were obtained with the less sensitive enzyme materials malt extract, takadiastase, and an *Aspergillus* amylase product prepared in the laboratory from takadiastase. Each of the four amino acids here studied, as well as aspartic acid and asparagine previously reported, showed a similar favorable influence upon the enzymic hydrolysis of the starch. The addition of a mixture of two of these amino acids produced no greater effect than would result from the same concentration of one of them. In these experiments the favorable effect of the added amino acid was not due to any influence upon hydrogen-ion concentration nor to combination of the amino acid with the product of the enzymic reaction. On the other hand, it is shown that the addition of one of these amino acids is a very effective means of protecting the enzyme from the deleterious effect of copper sulfate and may even serve to restore to full activity an enzyme which has been partially inactivated by copper.

A study of the influence of arginine, histidine, tryptophane and cystine upon the hydrolysis of starch by purified pancreatic amylase: H. C. SHERMAN and MARY L. CALDWELL. Arginine, histidine, tryptophane and cystine were tested as to their influence upon the amyloclastic activity of a purified preparation of pancreatic amylase and it was found that arginine and cystine have a favorable influence, while histidine and tryptophane do not. Since the conditions of the experiments were carefully controlled and were uniformly favorable as to hydrogen-ion concentration and kinds and amounts of salts present, the differences in results are due to the specific effects of the individual amino acids. That histidine and tryptophane should have a different influence from all the other amino acids studied in this and the preceding investigations may be due either to their heterocyclic structure or to their position in the protein complex which doubtless constitutes either the enzyme molecule itself or an essential part of it, or to both. The influence of chemical structure of added substances upon their effects on enzyme action is being studied further.

Concerning the nature of the toxic products of Bacillus botulinus: J. Bronfenbrenner and M. J. Schlesinger. As a result of growth of *Bacillus botulinus* on appropriate medium rich in nitrogen, there can be demonstrated in the culture filtrate toxic products of two kinds. One is heat resistant, soluble in alcohol and acts without the incubation period. This toxic product consists of ammonia salts and is readily destroyed by the addition of strong alkali. The other possesses the properties of a true bacterial toxin. It is thermolabile, it acts only after a definite period of incubation, is not soluble in alcohol, has antigenic properties, and is neutralized by a specific antibody. This toxin is quite distinct from other bacterial toxins in that (in its crude state) it is poisonous when taken by mouth, in addition to being poisonous by injection, as is also the case with other bacterial toxins. When purified, however, this toxin loses its toxicity by mouth, while its activity by injection remains unimpaired. When the fraction removed by purification is reunited with the purified toxin, the mixture recovers its toxicity by mouth. In addition to the properties already mentioned, this toxin exhibits other characteristics unobserved in connection with other bacterial toxins. For example it is not digested by either pepsin or trypsin. By a proper adjustment of the hydrogen ion concentration it can be rendered as much as 10^{12} times more potent than other toxins. Unlike other toxins, it must be of a comparatively simple chemical composition, as its molecular weight is not more than 260 with only 3×10^{-23} gms. of total nitrogen in one lethal dose for a mouse of 18 gms. It appears to be the most potent substance ever described.

The internal factor in photosynthesis: H. A. Spoehr.

Comparative stability of alkylbarbituric acids as determined by availability of nitrogen for fungus cultures: A. W. Dox, Lester Yoder, and Adelia McCrea. One of the criteria of synthetic hypnotics appears to be chemical stability. In the barbituric acid series, hypnotic properties are confined to the 5, 5-dialkyl derivatives, the 5-monoalkyl derivatives being physiologically inert. This difference may be due to a difference in chemical stability, since the monoalkyl derivatives contain a reactive hydrogen which might be a point of attack for biological oxidation. On this assumption, a difference should be expected in the utilization of the nitrogen by fungi. Cultures of *Penicillium expansum* were inoculated into a synthetic medium containing M/50 nitrogen in the form of alkylbarbituric acid. The series included eight mono- and seventeen di-alkyl-barbituric acids. A slight growth, far from normal, was obtained on all of the mono-alkyl derivatives, whereas the di-alkyl derivatives gave only germination similar to the controls without nitrogen.

The chemical composition of the body fluids of the sea-lion: R. E. Swain, and N. W. Rakestraw.

The molecular weight and transition point of gelatin: E. T. Oakes, and C. E. Davis.

The non-protein nitrogen of the hen's egg: J. S. Hepburn.

Biochemical studies of insectivorous plants: J. S. Hepburn, E. Q. St. John, and Frank M. Jones.

Studies on the digestibility of proteins in vitro. III. On the chemical nature of the nutritional deficiencies of arachin: D. Breese Jones, and Henry C. Waterman. Estimations of the digestibility *in vitro* of variously treated preparations of arachin (the principal protein of the peanut, *Arachis hypogæa*) by the method of Waterman and Johns indicate: (1) that this protein is incompletely digestible, and that this condition is not altered by boiling with water at ordinary pressure or by cooking under a steam pressure of 15 lbs.; and (2) that the nutritional failure of arachin is due to the retention of a considerable part of one or more of the essential amino acids, the most conspicuous of which is histidine, in the indigestible complex. The total amino acid composition of arachin would almost certainly be quite adequate, if it were available. The experiments indicate that the incomplete digestibility of arachin is not due to changes brought about by the treatment involved in its isolation, but is a native property of the protein. The high nutritional efficiency of peanut meal is therefore to be attributed to the presence in the meal of sources of amino acids which supply essentials contained in an unavailable form in arachin.

A chemical study of the proteins of the adsuki bean, Phaseolus angularis: D. B. Jones, A. J. Finks, and C. E. F. Gersdorff. Two globulins and a small amount of albumin have been isolated from the total proteins of the Japanese adsuki bean, *Phaseolus angularis.* The *a* globulin, obtained in 0.35 per cent. yield, was precipitated from a 5 per cent. sodium chloride extract of the bean meal by making the extract 0.3 saturated with ammonium sulfate, dissolving the resulting precipitate in distilled water and dialyzing the solution in running, chilled water for 9 to 12 days. This globulin coagulated at about 88° C. Elementary analyses of several preparations showed them to

have the following average percentage composition: C 52.75, H 6.97, N 15.64, S 1.21. Analyses by the Van Slyke method gave the following percentages for the diamino acids: Arginine 5.45, histidine 2.25, lysine 8.30, cystine 1.63.

The *b* globulin was precipitated from the saline extract of the meal at 0.65 to complete saturation with ammonium sulfate. This globulin coagulated at about 97° C, which is 10° higher than that of the *a* globulin. It had the following average elementary percentage compositions: C 53.57, N 6.79, N 16.46, S 0.40, and gave by the Van Slyke method: Arginine 7.00 per cent., histidine 2.51 per cent., lysine 8.41 per cent. and cystine 0.86 per cent. The bases were determined also by the absolute method of Kossel and Kutcher with the following results: Arginine 5.08 per cent., histidine 1.75 per cent. and lysine 4.17 per cent. A yield of 2.13 per cent. of tyrosine was also isolated. The most striking difference between the two globulins lies in their sulfur content. Both gave a qualitative test for tryptophane, although faint and slow to develop in the case of the *a* globulin.

The hydrolysis of casein and deaminized casein by enzymes: HOWARD B. LEWIS, and MAX S. DUNN. A study has been made of the digestion *in vitro* of casein and deaminized casein by pepsin, trypsin and erepsin. Both proteins were readily digested by pepsin and trypsin. Erepsin digested casein readily, but attacked deaminized casein only after the preliminary action of pepsin or trypsin. In every case the digestion of deaminized casein proceeded at a slower rate than the digestion of casein.

Synthesis of glycocoll and glutamine in the human body. C. P. SHERWIN.

Revision of Rosanoff's diagram of the aldose sugars: J. J. WILLAMAN and CLARENCE A. MORROW. Rosanoff's diagram showing the structural and genetic relationships among the aldoses is modified and extended. The objects of the revision are: (1) to include all aldoses so far prepared; (2) to rearrange the positions in the diagram so as to obtain geometrical perfection in showing the stereochemical progressions; and (3) to include in the diagram the following facts which were not included in the original: (*a*) the name of the sugar, (*b*) its specific rotation, and (*c*) its occurrence, whether natural or synthetic. Besides these, the facts in the original are also retained: (*d*) the projection formula by means of a symbol, (*e*) the original Fischer designation of family relationship, whether *d* or *l*, and (*f*) an index number, which, referred to a legend, gives the name of the alcohol and the dicarboxyllic acid derivative of the sugar. The revised diagram simplifies the study of stereoisomerism in the sugar group, and argues for the adoption of a rational system of nomenclature in this group.

The constitution of inulin: J. J. WILLAMAN.

Biochemistry of plant diseases. IV. *Effect of the brown rot: Fungus on plums:* J. J. WILLAMAN and F. R. DAVISON. Two varieties of plums resistant to brown rot, and two non-resistant, were picked at three stages of maturity, and subjected to analysis before and after rotting by *Sclerotinia cinerea.* The ash, nitrogen, CaO, ether extract, and crude fiber were consistently higher in the rotted samples, due no doubt to loss of dry matter by respiration. The resistant varieties contained much more crude fiber, but less of the other constituents than the non-resistant. The quality and quantity of the structural elements in the flesh are apparently important factors in resistance properties.

Rennet content of pancreatic extract—method for its isolation: ALBERT A. EPSTEIN. The presence of this enzyme in the pancreas can be readily demonstrated in a number of ways: (1) By heating the secretion or extract of the pancreas (in solution) to temperatures ranging from 50° to 65° C. for a period of 10 to 15 minutes, the most favorable temperature being 60° C. At this temperature and those above it, flocculation occurs and the ferment, which is soluble, remains in the fluid portion. (2) Treatment of the pancreatic ferments by means of colloidal iron and other precipitants such as uranium acetate, alcohol, and sodium sulphate (to saturation). (3) Addition of peptone mixtures such as those of gliadin and Witte's to the pancreatic juice or extract liberates the rennet. (4) Serum of a rabbit immunized by intravenous injections of pancreatic extract when added to the pancreatic extract liberates the rennet. It is concluded from these experiments that rennet is constantly present in the pancreatic secretions and extracts, not as a pro-enzyme but as an active enzyme admixed with substances which are antagonistic to it.

The immunizing substance of the pneumococcus: WILLIAM A. PERLZWEIG. The immunizing substance of the pneumococcus was found to be attached to the protein fraction of the cell. Being resistant to the action of proteolytic enzymes, it can be detached from the proteins by subjecting the bacteria to prolonged tryptic action and further separated by extraction of the digest with an excess of alcohol or acetone. The alcohol soluble

antigen is soluble in water, but it is not extracted from its aqueous solution by lipin solvents. It is heat stable in acid solution. The aqueous solution obtained from the alcoholic extract appears to possess the complete immunizing properties of the original pneumococci when tested prophylactically upon white mice, inducing in the animals an active immunity of a high degree. The antigenic fraction of pneumococci appears to be associated with the vitamine fraction.

Biochemical studies in pellagra: M. X. Sullivan. In the chemical studies of the patients at the Pellagra Hospital, Spartanburg, S. C., no marked evidence of acidosis was noted, though the patients as a whole tended to minimum normal levels. In general the mixture afforded by the results of the biochemical study of patients in the active stage of the disease is that of malnutrition and low protein metabolism with in general a low total nitrogen excretion, a heightened ammonia ratio with low uric and create a low area and a low ratio of urea nitrogen to total nitrogen. The undetermined nitrogen in the active stage of the disease is much higher than normal and contains basic material.

The chemical composition of decayed tomatoes: R. T. Balch and I. K. Phelps. A chemical study of tomatoes decomposed by two molds that cause "soft rots," namely, "*Rhizopus nigricans*" and "*Oidium lactis*" showed a decrease in the sugar content, the acidity, the nitrogen, and to a slight extent the citric acid. There was always a formation of ammonia. These determinations as well as those of the phosphorous in the insoluble solids, the nitrogen in the insoluble solids before and after treatment with 50 per cent. potassium hydroxide, the soluble protein nitrogen and the distribution of the soluble nitrogen would not serve as a means of detecting spoilage in tomato products, excepting in cases where a physical examination would suffice, for the following reasons: (1) The constituents of the tomato are variable. (2) The percentage composition of the tomato is not dependent upon the composition of the tomato alone but varies with the many different processes through which the product goes during its manufacture. (3) The small amount of spoilage that would probably be present would not materially change the composition of the product.

Energy expenditure in sewing: C. F. Langworthy and H. G. Barott. The respiration calorimeter was used to measure the energy expended by a woman hemming by hand on various materials and at different speeds, and doing similar sewing on a machine driven by foot power and by electricity. Little variation was found in the energy required for hand hemming on fine handkerchiefs, cotton sheets, 8-ounce cotton duck, and army blankets, the energy required for the actual sewing ranging from 4.3 calories per hour in the case of army blankets to 5.8 calories in the case of handkerchiefs. When the speed of sewing was increased, the energy output increased proportionately. Hemming sheets on a foot-driven machine required about six times as much energy per hour as doing the same work by hand, but the energy used per meter of sewing was hardly one half as great. When an electrically driven machine was used the energy required per hour was not quite twice that used for hand sewing and about one fourth that for the foot-driven machine; the energy per meter of sewing was about one fifth of that measured on the foot-driven machine and less than one tenth that of hand sewing. A three weeks' attack of influenza during the progress of the experiments made it possible to compare the energy output of the subject before and after the infection. For five weeks after apparently complete recovery her energy expenditure per kilogram of body weight averaged nearly 4 per cent. lower than before her illness.

Loss of carbon dioxid from dough as an index of flour strength: C. H. Bailey and Mildred Weigley. Two groups of factors appear involved in determining baking strength of flour: (*a*) the rate of gas production and (*b*) gas retention in the dough. The former can be varied in the desired direction, while the latter is apparently related to the percentage and physical properties of the gluten proteins and is more difficult to control. A study of the rate of expansion, and the loss of carbon dioxid from doughs made with strong and weak flours indicates that weak flour doughs lose more carbon dioxid per unit increase in volume than do strong flours. The loss of carbon dioxid per unit volume increase is suggested as a useful criterion of comparative strength of flours.

Studies of wheat flour grades. III. *Effect of chlorine bleaching upon the electrolytic resistance and hydrogen-ion concentration of water extracts:* C. H. Bailey and Arnold Johnson. Bleaching of flour with chlorine effects an appreciable increase in the conductivity and hydrogen-ion concentration of its water extract. The modification of these properties is in direct ratio to the quantity of chlorine employed in treating the flour.

Charles L. Parsons,
Secretary